

هندسة النظام

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الخميس

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صفحة 1

* Signals & Systems

↓
 $f(t)$ physical Quantity
هي دالة في الزمن لا كمية
غير يائية

* Signals Classification

- Analog vs Digital
- Deterministic vs Random
- Periodic vs aperiodic

* System



- system classification

- ① → Static vs Dynamic
- ② → linear vs Nonlinear

Ex:

$$y(t) = x(t) \cos \omega t$$

$$y(t) = |x(t)|$$

$$a_1 x_1(t) \rightarrow y_1(t) = a_1 x_1(t) \cos \omega t$$

$$a_1 x_1 \rightarrow y_1 = |a_1 x_1|$$

$$a_2 x_2(t) \rightarrow y_2(t) = a_2 x_2(t) \cos \omega t$$

$$a_2 x_2 \rightarrow y_2 = |a_2 x_2|$$

$$a_1 x_1 + a_2 x_2 \rightarrow y_3 = y_1 + y_2$$

$$a_1 x_1 + a_2 x_2 \rightarrow y_3 = |a_1 x_1 + a_2 x_2|$$

$$y_1 + y_2 = |a_1 x_1| + |a_2 x_2| \neq y_3$$

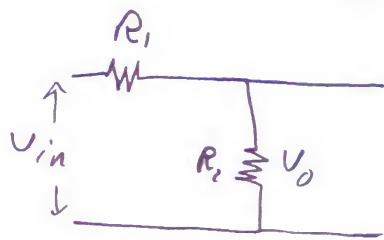
- ③ → Time Variance vs Time invariance

we will deal with **LTI** Systems → linear time invariance

to simplify our study

①

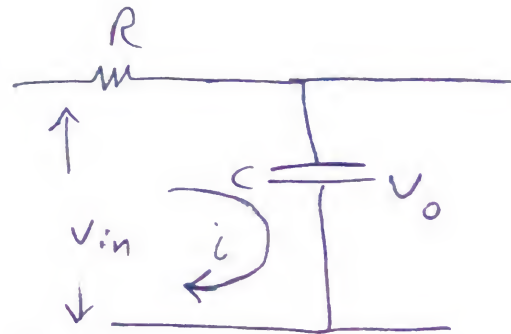
System Modeling



Static System

$$V_o = \frac{R_2}{R_1 + R_2} V_i$$

Transfer function
is o/p divided by
I/rp in s domain
with zero initial
conditions



$$i = \frac{V_i - V_o}{R}$$

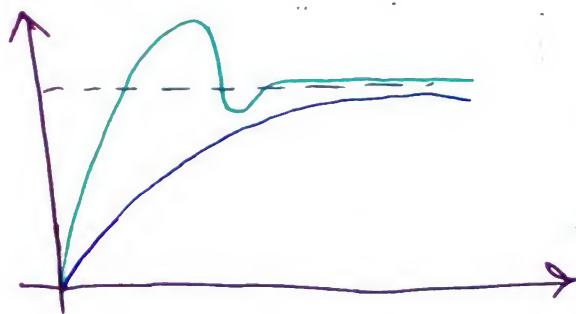
$$C \frac{dV_o}{dt} = \frac{V_i - V_o}{R} = i$$

$$RC \frac{dV_o}{dt} + V_o = V_i$$

$$RCS V_o + V_o = V_i$$

$$(RCS + 1) V_o = V_i$$

$$\frac{V_o}{V_i} = \frac{1}{1 + RCS}$$



$M_p \rightarrow$ maximum overshoot

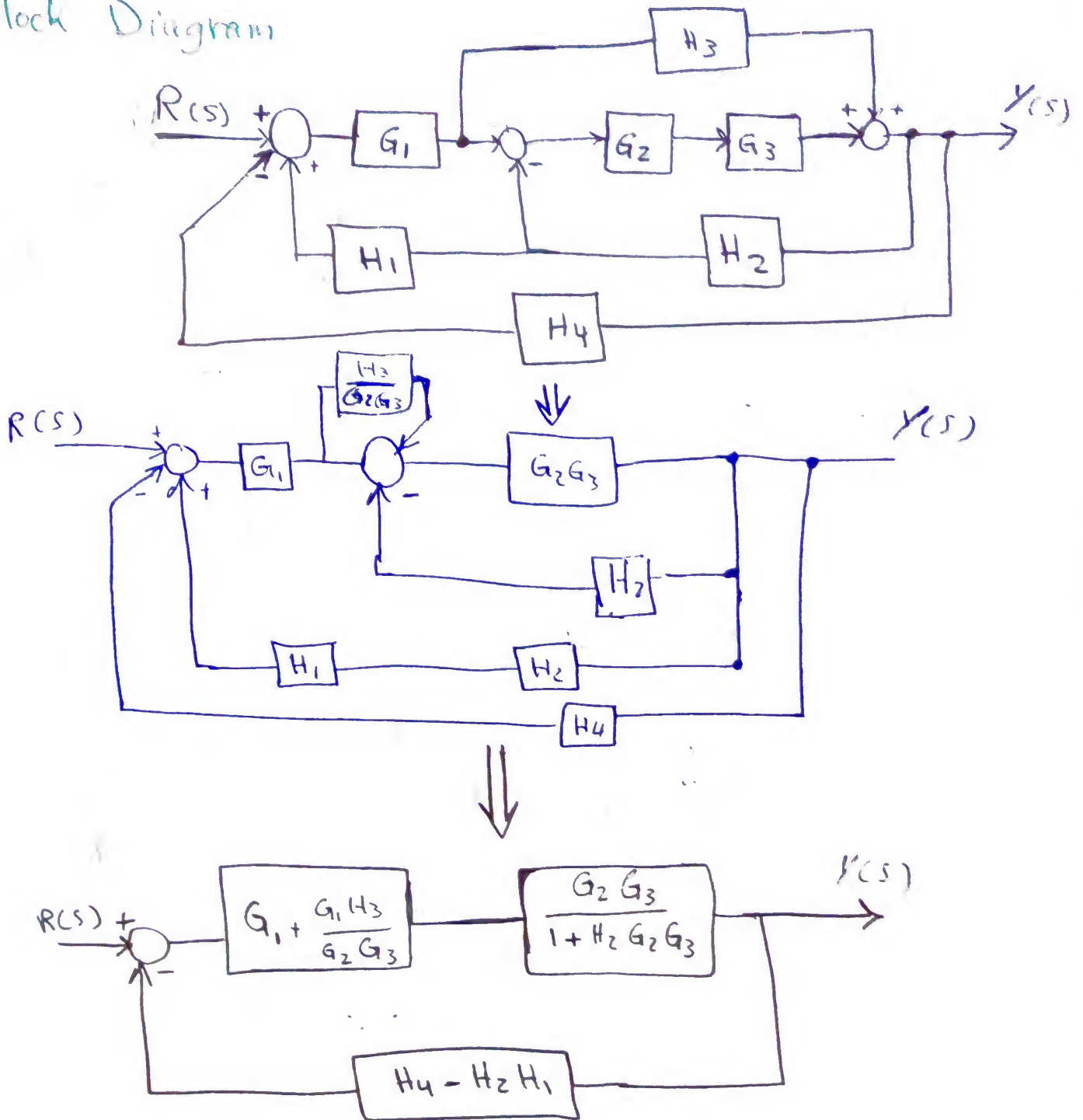
$t_s \rightarrow$ settling time

$t_r \rightarrow$ rise time

$e_{ss} \rightarrow$ steady state error

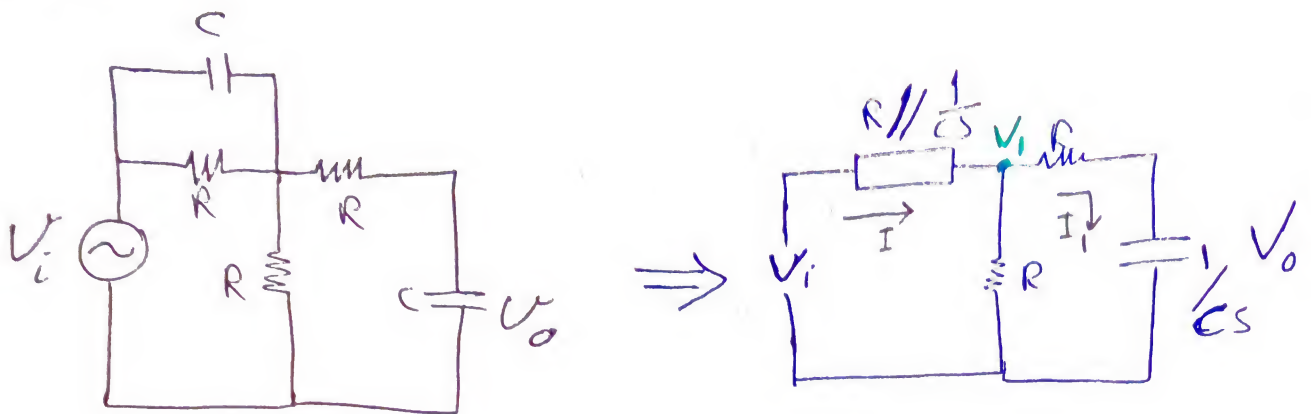
M_p, t_s, t_r and e_{ss} are essential for controller design, and most control systems are feedback systems

- Block Diagram



⇒ Turn Over

Ex:



$$\frac{V_o}{V_i} = \frac{I_1 / Cs}{I Z_{eq}}, \quad I_1 = I \frac{R}{2R + \frac{1}{Cs}}$$

$$= \frac{R Cs}{2R Cs + 1} I$$

$$\frac{V_o}{V_i} = \frac{R}{2R Cs + 1} \cdot \frac{1}{Z_{eq}}$$

$$Z_{eq} = (R \parallel \frac{1}{Cs}) + ((R + \frac{1}{Cs}) \parallel R)$$

$$= \frac{R / Cs}{R + \frac{1}{Cs}} + \frac{(R + \frac{1}{Cs}) R}{R + (R + \frac{1}{Cs})}$$

$$= \frac{R}{R Cs + 1} + \frac{(R Cs + 1) R}{2R Cs + 1}$$

$$= \frac{R Cs + 1}{(2R Cs + 1) + (R Cs + 1)^2}$$

$$= \frac{R Cs + 1}{(R Cs + 1)(2R Cs + 1)}$$